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Population and Migration Statistics: Projections Sub-Group August 2015 Meeting

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What is a Single Region Migration Model?

- A model where the migration of a chosen region is estimated by a single number for immigration and a single number for emigration.
- These numbers tell us how many people migrate to or from the region.
- It doesn't tell us which other regions the migrants have come from or which other regions they are going to.



An Example

Consider a country with four regions:

Region A, Region B, Region C, Region D

Suppose that there are 1,000 out-migrants from Region A.

In the single region model we can estimate this number.

But, we don't know how many of the 1,000 out-migrants went to Regions B, C, and D.



What is a Multi Region Migration Model?

- A model where many regions contribute to the migration of a chosen region.
- Each region has in-migration from the chosen region and this sums to the out-migration for the chosen region.
- Each region has out-migration to the chosen region and this sums to the in-migration for the chosen region.
- In this way each region contributes to the migration of every other region.



An Example

Consider again the four regions, A, B, C, and D.

In the multi region model we estimate the following migration:

- Region A to B: 300 people.
- Region A to C: 500 people.
- Region A to D: 200 people.
- etc.

We estimate the migration from every region to every other region and then aggregate these estimates to get the in-migration and out-migration to a region.

Therefore we have $300 + 500 + 200 = 1,000$ out-migration from region A.



What are Migration Flows?

- In a flow based model migration is estimated explicitly.
- A long-term assumption is made and migration is assumed to reach this level by a future date and stay at this level for the remainder of the projection.
- A run-in period is assumed where the migration will approach the long-term assumption starting from the base year.



An Example

Let us consider region A where there were 1,000 out-migrants in the year to mid-2014.

We will project 25 years into the future from mid-2014.

After 10 years (from mid-2025) we assume there will be 1,600 out-migrants a year.

For years mid-2015 to mid-mid-2019 we will assume there will be 1,200 out-migrants a year.

For years mid-2020 to mid-2024 we will assume there will be 1,400 out-migrants a year.

Therefore we have a long-term assumption of 1,600 out-migrants and a run-in period of ten years with out-migration of 1,200 in the first five years, and 1,400 in the second five years.

What are Migration Rates?

- In a rates based migration model the migration is estimated by computing a rate.
- The rate is based on previous migration in the region, and also on the regions previous population.
- The rate is applied to the current population to produce new migration.
- Out-migration is calculated using this method.
- In-migration is calculated from aggregating out-migration from other regions.



An Example

Consider region A at mid-2014 with the following:

Population: 10,000

Out-Migration: 1,000

The migration rate is as follows:

$$\text{Migration Rate} = \frac{\text{Out-Migrants}}{\text{Population}} = \frac{1,000}{10,000} = 0.1$$

Suppose at mid-2015 the population is 11,000 then:

$$\begin{aligned}\text{Out-Migration} &= \text{Migration Rate} \times \text{Population} \\ &= 0.1 \times 11,000 = 1,100\end{aligned}$$

The Rates Based Migration Model Adjustment

What is the adjustment?

- The adjustment was developed by Statistics Canada.
- It was developed to account for large discrepancies observed amongst projected populations for Canadian provinces/territories which were atypical to those observed during the reference period.

How does it work?

- Without the adjustment: migration rates are calculated using previous trends in migration and the population at risk of migrating.
- With the adjustment: the migration rates have the destination of the migrants applied as a constraint.

Why do we need an adjustment

- Scottish Council areas have populations which differ from each other, similar to how Canadian provinces/territories do.
- Experience from the National Projections process indicates that multi-region modelling of UK countries causes a similar situation as has happened in Canada.

However...

- We don't know that the adjustment needs to be applied until we can look at the results of the new projections.
- We plan on running simulations to determine whether it is appropriate to use the adjustment.

Age-Specific Mortality Rates & Age-Specific Fertility Rates

- In the projection of births we use *Age-Specific Fertility Rates (ASFR)*.
- In the projection of deaths we use *Age-Specific Mortality Rates (ASMR)*.
- The *ASFR* is the total number of live births per 1,000 women at a given age.
- The *ASMR* is the total number of deaths per 1,000 people at a given age.
- The *ASFR* and *ASMR* are calculated at Scotland level by the ONS for the National Projections.



An Example

Consider 25 year old females.

Population: 2,000 Deaths: 80 Births: 120

The ASFR is as follows:

$$\begin{aligned} ASFR &= \frac{\text{Births}}{\text{Population}} \times 1,000 = \frac{120}{2,000} \times 1,000 \\ &= 60 \text{ births per 1,000 women aged 25} \end{aligned}$$

The ASMR is as follows:

$$\begin{aligned} ASMR &= \frac{\text{Deaths}}{\text{Population}} \times 1,000 = \frac{80}{2,000} \times 1,000 \\ &= 40 \text{ deaths per 1,000 women aged 25} \end{aligned}$$

Scaling Fertility & Mortality

- To estimate births and deaths at Council level we first calculate scaling factors to apply the national *ASFR* and *ASMR*.
- The scaling factors are a ratio:
 - A value greater than 1 for a region indicates fertility or mortality greater than that for Scotland.
 - A value less than 1 for a region indicates fertility or mortality less than that for Scotland.

Projecting Births & Deaths

- To calculate births we take an average* of the current and new population of fertile women and apply the scaling factor and *ASFR* to them
- To calculate the deaths we take the current population and half of the net migrants* and apply the scaling factor and *ASMR* to them.
- This produces projected births and deaths for a given year.

* The average in the births calculation, and the presence of half the net migrants in the deaths calculation allow us to project births and deaths for people who arrive throughout the year and subsequently give birth and/or die.